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The role of Urban Living Labs in a Smart City

Bastiaan Baccarne*

iMinds-MICT-Ghent University, Korte Meer 7-9-11, Ghent, Belgium
E-mail: bastiaan.baccarne@ugent.be

* Corresponding author

Dimitri Schuurman

iMinds-MICT-Ghent University, Korte Meer 7-9-11, Ghent, Belgium
E-mail: dimitri.schuurman@ugent.be

Peter Mechant

iMinds-MICT-Ghent University, Korte Meer 7-9-11, Ghent, Belgium
E-mail: peter.mechant@ugent.be

Lieven De Marez

iMinds-MICT-Ghent University, Korte Meer 7-9-11, Ghent, Belgium
E-mail: lieven.demarez@ugent.be

Abstract: In a rapidly changing socio-technical environment cities are increasingly seen as main drivers for change. Against this backdrop, this paper studies the emerging Urban Living Lab and Smart City concepts from a project based perspective, by assessing a series of five Smart City initiatives within one local city ecosystem. A conceptual and analytical framework is used to analyse the architecture, nature and outcomes of the Smart City Ghent and the role of Urban Living Labs. The results of our analysis highlight the potential for social value creation and urban transition. However, current Smart City initiatives face the challenge of evolving from demonstrators towards real sustainable value. Furthermore, Smart Cities often have a technological deterministic, project-based approach, which forecloses a sustainable, permanent and growing future for the project outcomes. 'City-governed' Urban Living Labs have an interesting potential to overcome some of the identified challenges.

Keywords: Smart Cities; Urban Living Labs; Quadruple Helix; Socio-technical Innovation; Innovation Ecosystems; Urban Transition; Sustainable Innovation

1 Introduction

Continuous urbanization increasingly moves the locus of societal change towards cities. Nowadays cities play a growing role in the lives of the vast majority of people and are becoming central platforms for knowledge exchange and value generation. At the same time, cities with dense populations (and society at large) are facing so-called grand societal challenges. Although these challenges transcend regions, nations and even continents, cities are often seen as the main driver for change. From this point of view, cities host the locus of problems and challenges, as well as the potential solutions to overcome these problems and evolve towards a sustainable future-proof society. Meanwhile, we are witnessing new social movements that could not have happened (the same way) without the presence of new media. Worldwide, ad hoc (online) action groups (e.g. the Occupy movement) are able to assemble faster than ever before to call for change with a unified voice (Castells, 2012). On a local level, governments are exploring possibilities to let their citizens participate through new media and other interaction platforms (Coleman & Blumler, 2009) and networks of citizens are making use of new media to increase their participation and pressure on local democratic processes (Tambini, 1999). The classic triadic relationship of power between public actors, private actors and citizens seems to be under pressure, both in practice and on a theoretical level. These evolutions force cities to look for new ways to reinvent themselves (Viitanen & Kingston, 2013). However, while urban new media are rapidly changing the social fabric of everyday life in the city (Atkinson, 1998; Foth, 2009), local governments still lack the capability and resources to react in a flexible way (O'Flynn, 2007). In the search for new ways to cope with this tension, transparency and close interaction with grassroots initiatives is increasingly put forward as one of the solutions to overcome this gap (ARUP, 2010). This strategy is, to some extent, in line with the open innovation (Chesbrough, 2003) framework, causing cities to question the dominant paradigm of top-down innovation development and implementation, and to experiment with city innovation processes together with, and by citizens (Paskaleva, 2011).

Recent technological evolutions have also fostered a fresh belief in the positive effects of innovative technologies in a city. The combination of smart (technology enabled) solutions to solve societal challenges and the focus on the city as the main driver of change led to the concept of 'Smart Cities'. Despite the increasing support for these initiatives, however, only little research exists on the actual value creation and innovation development processes in Smart Cities and the mechanisms that allow the exchange of value and knowledge within this innovation ecosystem. While the focus is slowly shifting from 'smart technologies' towards 'smart citizens', such citizen-centric innovation development needs to be governed and in some way be able to connect the traditional top-down approach with a grassroots or bottom-up approach.

This paper analyses urban transitions and citizen empowerment in innovation development processes, enabled by Urban Living Labs in Smart Cities. Founded on a city stakeholder model, the architecture, nature and outcomes of five Smart City projects are being discussed. While academic work on Living Labs is slowly growing mature, the application of this framework for the development of Smart City solutions is less explored. With cities as key stakeholders and the importance of public value, Urban Living Labs have a distinct nature when it comes to governing innovation development processes ‘with’ and ‘by’ citizens. First, we analyse some of the main dimensions which appear in Smart City literature and propose a conceptual framework, mapping the different actors and the setup of Smart City initiatives. This enables us to assess in which way and to what extent public and economic value is being generated and what the role of Urban Living Labs is in these processes.

2 Literature review

Smart Cities

The integration of ICT in urban development and management has been studied from different angles. Concepts that often occur in this context are ‘intelligent cities’, ‘digital cities’, ‘ubiquitous cities’ or ‘Smart Cities’. Although the ‘Smart City’ concept is often used as a marketing concept by both cities and businesses to envision a city of the ‘future’ or ‘future-proof’ city, it emphasizes the growing importance of innovative technologies in the city to solve societal challenges, such as ecological issues, social isolation, sustainable use of resources, mobility challenges and to increase the overall ‘quality of life’ in the city. Caragliu et al. (2009, p.50), state that a city is smart when “investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance”. In other contexts ‘smartness’ refers to context-aware systems, ubiquitous computing and Internet-of-Things technologies (ITU, 2005).

The related concepts ‘ubiquitous cities’ or ‘U-cities’ are often used to refer to “a next generation urban space that includes an integrated set of ubiquitous services” (Kwon & Kim, 2007, p.143). Examples are Helsinki’s Virtual Village, U-Seoul and the Lower Manhattan project (Shin, 2009). ‘Digital cities’ are defined as “extensive information systems […] that collect and organize the digital information of the corresponding ‘physical cities’ and provide a public information space for people living in and visiting them” (Loukis, Charalabidis, & Scholl, 2011, p.144). Ergazakis and Ergazakis (2011) state that these ‘digital cities’ should offer innovative services targeting various stakeholders that are inherent to a city environment (administrations, citizens and businesses), focusing on interactions between different city stakeholders (Ergazakis & Ergazakis, 2011; Middleton & Bryne, 2011). Similar to the notion of digital cities is the idea of ‘intelligent cities’, which aims at uniting, promoting, acquiring and stimulating diffusion of information. In order realize this, an ‘intelligent city’ should develop and implement electronic and digital technologies in the city (Komninos, 2008).

While the first generation of so-called ‘Smart City’ projects and literature has a rather technological-deterministic point of view (Cosgrave & Tryfonas, 2012), this is changing slowly towards a more citizen-centric approach, focusing on smart citizens rather than on the Smart City as a high-tech solution to urban challenges (Dameri, 2013). These initiatives embrace more user-centric points of view, such as an increased attention for user innovation, co-creation and collaboration with a wide variety of city stakeholders (Caragliu et al., 2009). Second generation Smart City projects and strategies thus aim to increase the quality of life in the city, using innovative methods and building on multi-stakeholder participation and engagement, for which innovative technologies serve as an enabler rather than as a driver.

Urban Living Labs

The collaborative nature of Smart Cities is related to the Living Lab-concept and the quadruple helix-models for innovation. Triple and quadruple helix-models facilitate exchange of ideas and technologies, with fewer barriers between academia, end-users, policy and industry (Arnkil, Järvensivu, Koski, & Piirainen, 2010; Etzkowitz, 2008). Living Labs, on the other hand, are ecosystems in which end-users and other stakeholders are involved in the development of an innovation over a longer period of time, in a real-life environment, using a multi-method approach, following an iterative process (Niitamo & Kulkki, 2006; Schuurman, Lievens, De Marez, & Ballon, 2012). Living Labs facilitate university-industry relationships, but also relationships between large companies and SME’s, start-ups, entrepreneurs, and, most importantly, involve the end-users themselves, commonly referred to as public-private-people partnerships (Westerlund & Leminen, 2011). These collaborative ecosystems promise to facilitate knowledge exchange among the ecosystem actors (Buitendag, van der Walt, Malebane, & de Jager, 2012; Feurstein, Hesmer, Hribernik, Thoben, & Schumacher, 2008). In EU programs such as i2010 and Europe 2020, the importance of Smart Cities is highlighted, and the Living Lab-approach is considered a best practice in this context as it enables structuring user interaction by keeping users continuously involved in making better products and services while their expectations are continuously monitored and reflected upon in a systematic process (Paskaleva, 2011).

The relationship between the urban context and the Living Lab approach, however, is underexposed in current academic literature. As we discussed before, cities are transforming under the influence of rapid socio-technical innovations (Atkinson, 1998), and urban new media empower citizens through the democratization of knowledge and the availability of interactive ICT platforms (Castells, 2012; Tambini, 1999), causing cities to become central platforms for knowledge exchange and value generation. Against this backdrop, citizens are increasingly enabled to mold and tune their own urban environment and to collaborate with others to reach common goals (Foth, 2009). Nevertheless, city governments still struggle to cope with this unbounded citizen empowerment, since these grassroots initiatives take ownership of issues and solutions through decentralized networks (de Lange & de Waal, 2013) beyond governmental governance. One of the frameworks that try to overcome the tension between bottom-up initiatives and top-down governance is the Living Lab approach (Almirall, 2008). Through the translation of Living Lab principles to an urban environment, (smart) cities can foster user-innovation and tailor innovations to the needs of their citizens by stimulating collaborative development of innovations with multiple stakeholders. Juujärvi & Pesso (2013, p.22) define Urban Living Labs as "a physical region in which different stakeholders form public-private-people partnerships of public agencies, firms, universities, and users collaborate to create, prototype, validate, and test new technologies, services, products, and systems in real-life contexts". While most Living Labs facilitate interaction between end-users and private actors, Urban Living Labs are oriented on 'urban' or 'civic' innovation. This means that Urban Living Labs are often supervised by (or have a close relation with) the local government and have a strong focus on social value creation and civic engagement.

Empowered cities?

Both Smart Cities and (Urban) Living Labs have been increasingly stimulated by (trans)national governments (e.g. the European Commission) and international networks (e.g. EuroCities) over the past years. The availability of funding and emerging enthusiasm about the first Smart City success stories has led to a boost in smart city initiatives worldwide. While both research and policy often promise disruptive solutions, improvement of life in the city and economic growth, there is a vast lack of knowledge concerning the actual value that is being created in a Smart City and the processes that allow the exchange of value and knowledge. Because it is often difficult to assess or define this concept in actionable, tangible elements, we will make this assessment based on five Smart City projects in the city of Ghent, Belgium.

Based on quadruple helix and Living Lab literature the 'architecture' of a Smart City can be represented as a fourfold network (policy, citizens, research and private partners). In the Smart City as an ecosystem, value and affordances flow between the different actors (see figure 1). In our conceptual framework, value consists out of two dimensions: socio-economic value and affordances. Affordances can be conceptualized as 'what one system provides to another system'. An affordance also encompasses the perceived functional significance of that system for an individual. For our purposes, we use the definition of affordances by Norman (2002), describing them as: "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (p. 9). In our analysis, these affordances are approached as 'enabling dimensions'. Mapping these interactions allows analysing the Smart City **actor involvement** (logical) and the intensity of the **network collaboration** (numeric). Using social network analysis, this could be described as a valued network and used to calculate numeric evaluation parameters for the ecosystem involvement.

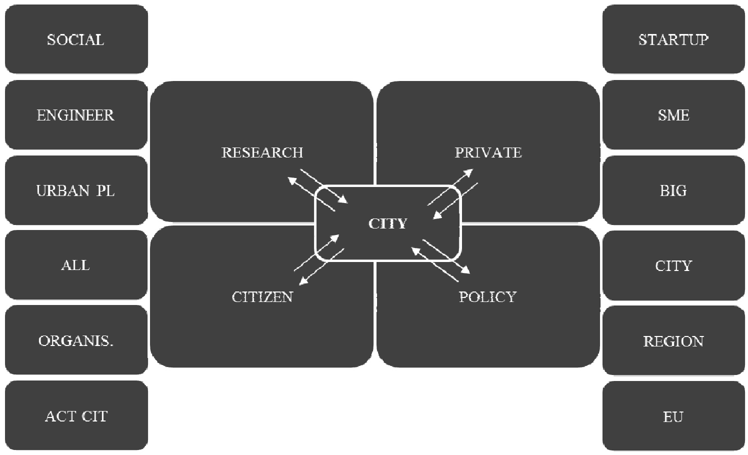

Figure 1 Conceptual model for value and affordance flows in a Smart City.

Besides interactions of affordances, each chain of affordances aims at generating value. In our analysis, a distinction is made between the generation of **public value** (e.g. safer streets) and **economic value** (e.g. generation of revenue). The concept of 'public value' refers to the value that is generated through the creation and implementation of services and technologies that adequately harness opportunities within the city, tackle societal challenges and/or realize policy goals (Cosgrave & Tryfonas, 2012). It refers to, for example, reducing traffic jams, emancipating citizens, increasing neighbourhood cohesion, etc. 'Economic value' on the other hand covers economic metrics such as the annual economic growth of cities and companies within the city, a decrease in unemployment, the extent to which new businesses (start-ups) are being generated and able to survive, a reduction of bankruptcies, an increased competitive advantage, attracting existing businesses to the city, etc.

A third key dimension in the evaluation of Smart Cities is the degree of **techno-centricity** and the importance of **knowledge reuse**. Besides a growing attention for the 'Smart Citizen' instead of smart technologies as such (as discussed before), the growing amount of Smart City projects raises the question whether each of these projects generates new knowledge. From this perspective, it is important to build upon previous projects and related knowledge. As explained by Basili et al.(1996), reuse processes can play a crucial role in the success of private entrepreneurial initiatives as well public projects. Reuse is critical, as it allows working on existing artefacts instead of starting from scratch, thereby enabling the development and deployment of software and services with greater ease. Consequently, time and human effort required to develop software product and pilots can also be effectively reduced. In addition to this, iterative reuse can also have a relevant, verifiable impact on product productivity and quality, as reusing existing artefacts can iteratively improve the quality of the software or pilot.

A final analytic dimension concerns the **sustainability** and '**future-proofness**'. Most Smart City projects and strategies focus on "sustainable urban development, fuelling sustainable economic growth […] with a wise management of natural resources" (Caragliu et al., 2009). Since sustainability is this central in Smart Cities, a critical analysis to assess to what extent the projects actually are sustainable is indispensable for every Smart City evaluation framework.

3 Research design

Due to the long-term nature of Smart City projects and the exploratory nature of our assessment, a multidimensional comparative case-study analysis seems the most suitable approach (Yin, 1984). On top of that, case studies are most suited for processes which are poorly understood and lack a (solid) theoretical foundation (Eisenhardt, 1989) and allow to analyse the process open-ended and on multiple levels (Yin, 1984).

The next section discusses the theoretical concepts of Smart Cities and Urban Living Labs by means of a comparative analysis of five Smart City projects within a single local ecosystem, based on the discussed analytical dimensions. The decision to constrain ourselves to a single local ecosystem allows a better comparison and neutralizes potential bias due to cultural or political differences (internal validity), although this might hinder generalizability (external validity). For this analysis, five projects were selected using three criteria: the project had to (a) take place in the city of Ghent, Belgium; (b) be referred to as a 'Smart City project' in the project documents and (c) have a collaborative nature.

The analysis in this paper is being performed based on ethnographic observations and adjuvant individual interviews with local civil servants involved in these activities. As research partners in the selected projects, we were able to use research results (documents) as well as our own experiences (participatory observation/action research) and lessons learned (soft data). The following hard data sources were used for our analysis: (a) meeting reports of steering committees (b) initial project proposals and project reports and (c) project deliverables. The selected projects for the analysis in this paper are Citadel[1], Zwerm[2], Mijn digitaal idee voor Gent (MDIVG)[3], Apps for Ghent (A4G)[4] and Future legends[5].

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[1] http://www.citadelonthemove.eu/

[2] https://www.zwermgent.be/

[3] For academic research on this project see (Mechant, Stevens, Evens, & Verdegem, 2012) and (Schuurman, Baccarne, Mechant, & De Marez, 2012)

[4] http://appsforghent.be/

[5] http://www.mediatuin.be/projecten/future-legends

Research context: Ghent Living Lab

Ghent Living Lab (GLL) is an Urban Living Lab, governed by the city council. Key partners include the local government and its service partners, iMinds (Flemish organization supporting innovation in media and ICT), all major colleges and universities in the city, local (developer) networks and community organizations. Its primary focus is on Smart Cities and the development of Future Internet related services to support the further development of Smart Cities. GLL is also an effective member of the European Network of Living Labs.

4 Findings

Table 1 shows an overview of the multidimensional comparative case study analysis distinguishing the four main analytical dimensions (a) the collaborative nature of the Smart City project (b) knowledge and technology (c) creation of value and (d) the future of Smart City initiatives after the project ends. Performance measures were coded by the author team, based on project documents and insights gathered through project participation, and validated by external project stakeholders.

Table 1 Multidimensional comparative analysis of five Smart City projects

	Citadel	**Zwerm**	**Mijn digitaal idee voor Gent**	**Apps for Ghent**	**Future Legends**
Involves full Smart City ecosystem	Yes	Yes	No	No	No
Network collaboration	Medium	Medium	Medium	Medium	High
Created economic value	t.b.d.	Low	Low	Low	Low
Created public value	t.b.d.	High	Medium	Medium	High
Reuse of knowledge	Yes	Yes	No	No	No
Importance of technology	High	High	High	High	Low
Sustainability	t.b.d.	Low	Medium/ high	Medium/ low	High
Importance of funding	High	High	Medium	Low	Medium

Collaboration and ecosystem

The first dimension assesses whether the full Smart City ecosystem (four quadrants of the quadruple helix) is involved in the project or not. As was discussed above, an important element in Smart Cities is the way research, policy, private partners and citizens collaborate and share knowledge and services in order to optimally develop future products and services with a high sustainability. Nevertheless, only three out of five projects involve all four Smart City actors. The quadrant that is most often neglected is the private partner. This is challenging when the aim is to create economic value and forecloses the sustainability of the developed products and services. Without a private partner, Smart City projects have to rely on 'citizen entrepreneurs' or continuous project support by the public actor.

		Policy (city government)	Citizens	Private partners	Research
Citadel	Vi	Applications for an improved city environment (public value and potential economic value) and policy advise (enabling knowledge)	Opportunity to create own applications (enabling environment, enabling knowledge and enabling policy)	EU funding (enabling funding) and research insights (enabling knowledge)	EU funding (enabling funding)
	Vo	Open governmental data (enabling knowledge)	Applications for an improved city environment (public value and potential economic value)	Creation (enabling service) of an empowering platform (enabling environment)	User research (enabling service) + policy and development advise (enabling knowledge)
Zwerm	Vi	Policy advise (enabling knowledge)	Experimental socio-technical environment (enabling environment)	EU funding (enabling funding)+ Information on economic potential for enabling technology (enabling knowledge)	EU funding (enabling funding) + Raw data on citizen behavior (enabling knowledge)
	Vo	Facilitating the city as a laboratory (enabling environment)	Participation and behavioral data (enabling knowledge)	Provision of technical components (enabling environment)	Knowledge on human behavior and policy advice (enabling knowledge)
MDIVG	Vi	Ideas of citizens (enabling knowledge)	Empowerment platform (enabling environment)	---	Reuse of citizen input for academic analysis (enabling knowledge)
	Vo	City improvements (enabling policy) + city improvement (public value)	Ideas (enabling knowledge)	---	Insights on citizen participation (enabling knowledge)
A4G	Vi	Applications for an improved city environment (public value and potential economic value)	Open governmental data (enabling knowledge)	Open governmental data (enabling knowledge)	Low
	Vo	Open governmental data (enabling knowledge) and stimulate app development (enabling policy)	Apps based on governmental Open Data (public value and potential economic value)	Apps based on governmental Open Data (public, and potential economic value)	Low
Future Legends	Vi	Policy advise (enabling knowledge)	Experimental environment (enabling environment)	---	Raw data on citizen behavior (enabling knowledge)
	Vo	Project funding (enabling funding)	Project participation (feedback+ behavioral data) (enabling knowledge) and creation of their own radio service (public value)	---	Knowledge on human behavior and policy advice (enabling knowledge)

Figure 2 Mapping incoming and outgoing flows of affordances used to assess the nature and the intensity of the network collaboration (illustration, not elaborated upon).

Besides the involvement of all four Smart City actors, it is also interesting to elaborate on the intensity of the collaboration between Smart City project partners. The downside of involving the full ecosystem is that collaboration between partners becomes much more difficult and is more likely to be less intense. In the selected projects, the city government always acts as the main project coordinator, determining the degree of interaction with the other three actors. Overall, the intensity of collaboration is rather high, which can be explained by the policy goals, which focus more on the collaborative dimension of Smart Cities than on the technology dimension. For A4G and MDIVG, the main reason for a medium rating on collaboration is the lower interaction with research partners, which are either only using the generated data for academic purposes (MDIVG), only involved for the promotion of the research group (A4G).

Value creation

In the end, Smart City projects aim to generate economic and/or public value. While this is often part of the project legitimations when applying for funding, especially for the European Union, none of the selected cases was so far able to generate any substantial economic value. This is one of the biggest challenges for Smart City projects. If these projects are not able to boost economy or even be economically successful to be able to become autonomous, Smart City projects will always have to rely on governmental support and funding. Besides economic value, generated value can have a public nature as well. Especially when supported by public resources, this might also be a valid project legitimation. Although the concept of public value is much harder to assess, the selected Smart Cities projects tend to generate at least some public value. For Zwerm, this value was validated trough academic research, confirming that the project had improved social cohesion in local neighbourhoods (Coenen, Mechant, Laureyssens, Claeys, & Criel, 2013). The Future Legends project resulted in both valuable policy advice on the stimulation of cultural participation for urban youngsters as well as a community driven crowdsourced radio station (All, Coorevits, & Schuurman, 2013). For the other Smart City projects, the generated public value is more ‘fuzzy’ or still needs to be proven. Although the promises and project goals contain the creation of public value for all of the selected cases, it is unclear whether the creation of public value was actually achieved or not. In order to legitimize Smart City projects, it is important for these projects to validate the creation of public value by measuring its impact.

Knowledge reuse and technological determinism

Although academic literature stresses the importance of reuse processes, especially in the context of ICT enabled innovation projects, our analysis shows that only two of the selected Smart City projects fully incorporate reuse of knowledge and resources. ‘Citadel’ and ‘Zwerm’ are both part of collaborative European projects in which the reuse of the infrastructure and system logics in other cities is one of the main goals. This observation indicates the importance of knowledge brokers and facilitating networks in and between cities. From a reuse point of view, Urban Living Labs have in interesting (untapped) potential concerning the reuse of different networks (people and organizations), (technical) infrastructures, (governmental) data, code and knowledge. Such deployed innovation ecosystem, with the local government in a central enabling position, could integrate such resources in a single framework, increasing access for secondary use. This would greatly increase the connective capacity (Lichtenthaler & Lichtenthaler, 2009) of the innovation ecosystem. However, it is important for the governmental actor to choose its role in this ecosystem wisely. Such central governance cannot be about ownership, but should be about access.

While second generation Smart Cities shifted focus from ‘technology as a goal’ to ‘technology as enabler’, in practice most Smart City projects still have a technological-deterministic nature. They build upon the belief that (new) media and ICT solutions can improve life in the city and that technology is the main driver to solve the complex societal challenges we face in contemporary cities. Rapid socio-technological evolutions fostered a strong belief in the possibilities for Smart Cities. The central position of technology is also present in all selected Smart City projects, except one (Future legends). Whereas technology certainly enables a lot of new opportunities, it is dangerous to believe that technology as such is sufficient to create a ‘smarter city’. This potential can only be harnessed if it is embedded in a social context. Technology can support urban innovations, but to think of it as the main driver of social change is only a one-dimensional point of view. In order to overcome the short-term nature of Smart City projects and have impact over a longer period of time, the social context should be central in Smart City projects. Of our selected cases, Future Legends is the only project which became autonomous after the project ended. Not surprisingly, this project was the only one which used technology merely to serve social innovation.

Sustainability and ‘future-proofness’

Sustainability is the main bottleneck of all selected Smart City initiatives, with the exception of Future Legends. Smart City projects are often instigated and fuelled by (European) project funding. Once these projects finish, the generated technology, service and/or knowledge disappears. A second threat for the sustainability of Smart City projects is technological-determinism. When technology has a central position in the project, the social dimension and the supporting context surrounding the technology are of often neglected. Therefore, most Smart City projects have a hard time crossing the chasm from demonstrator towards an autonomous, sustainable product or service which can service without funding.

All of the cases with the exception of Apps For Ghent, relied on funding for the kick-start of the project. For the European projects (Citadel and Zwerm) this dependency remains very strong even after the project launched. Without funding, these projects (would) seize to exist. The local projects on the other hand rely less on European funding, but the downside of this is that this makes it hard for them to realize their full potential. These projects are governed by the city government, but the officials that are working on these projects have only little or no resources (especially time) to do so. In the case of Apps For Ghent, and especially for Ghent Living Lab, promises and opportunities are very high but both projects lack the resources to harness these opportunities to their full potential. The Future Legends project is somehow exceptional in the sense that this project is fully supported by the community and no longer needs external support.

Side note to sustainability: urban transition

With regards to the abovementioned lack of sustainability, a side note is required. While it is tempting to discuss the project outcomes as a tangible subject, more latent dimensions should also be taken into account. Central to the (Urban) Living Lab approach is to facilitate experiment in a real-life environment (Schuurman et al., 2013). By setting up such experimental environments, the potential of ideas can be experienced by the ecosystem, stimulating change on a higher level. In this context, Nevens et al. (2013) put forward the concept of the Urban Transition Lab which is described as "the locus within a city where (global) persistent problems are translated to the specific characteristics of the city […] It is a hybrid, flexible and transdisciplinary platform that provides space and time for learning, reflection and development of alternative solutions […]." Such approach is related to some of the principles of transition management (Schliwa, 2013). Transition management focusses on the governance of problem solving and improvements in societal systems and "[…] shapes processes of co-evolution, using visions, transition experiments and cycles of learning and adaptation" (Kemp, Loorbach, & Rotmans, 2007). From this point of view, experimental Smart City pilots can foster change on a more latent level, by inspiring and stimulating debate on contemporary urban challenges and solutions.

5 Conclusion & discussion

In a rapidly changing socio-technical environment cities are increasingly seen as main drivers for change. Urban new media empower citizens and facilitate interaction and knowledge exchange. However, collaborations and interaction between different city stakeholders needs to be governed. While first generation Smart City projects, strategies and academic literature has a rather technological-deterministic or techno-optimistic point of view, a reconceptualisation of the concept now puts the citizen in a central position. The concept of a 'Smart City' now holds the belief that cities can and should act as collaborative ecosystems, enabled by state-of-the art technology. It envisions cities as laboratories and drivers for change. The analysis presented in this paper highlight the creation of social value and the inspiring capacity, which potentially fosters long-term urban transition as main strengths of current Smart City projects. However, these projects still struggle to generate economic value and have issues with sustainability. Although strategies and project goals shifted away from a technological-deterministic discourse, practice shows that most Smart City projects still focus on technological innovation. Furthermore, most projects do not involve all quadruple helix actors although intense multi-stakeholder collaboration is a central element is Smart City projects. Especially the lack of involvement of private partners and attention for possible business models forecloses the long-term sustainability and economic value creation of Smart City projects. Although the selected projects all took place in the City of Ghent, they operated mainly next to each other without knowledge and infrastructural spill overs. While an increasing amount of Smart City projects are being set up, all focusing on efficiency and sustainability, the question rises whether each of these projects generates new knowledge. From this perspective it is important to build upon previous projects and related knowledge. Reuse of knowledge and infrastructure is critical, as it allows working on existing artefacts instead of starting from scratch, thereby enabling the development and deployment of software and services with greater ease.

City-governed Urban Living Labs allow systematic governance of stakeholder interactions and connect top-down policy and bottom-up interactions. However, these ecosystems still have a lot of potential to overcome some of the challenges of Smart City projects. This article considers an Urban Living Lab as a collaborative ecosystem allowing for the co-creation of sustainable, future proof innovations that improve life in the city and boost the economy, thereby contributing to Smart City targets. Such Urban Living Labs should act as 'reuse enablers' through central governance of 'fertilizing' resources. In the evolution towards an Open Government, the Urban Living Lab should also govern and disclose networks (interpersonal and inter-organizational), infrastructure (e.g. sensor networks), artefacts (e.g. code and algorithms) and knowledge (e.g. research data) to increase connective capacity (Lichtenthaler & Lichtenthaler, 2009) in the city, thus enhancing the sustainability of the generated value and knowledge.

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